Survey Report

BIG BEND-PALOUSE-LOWER SNAKE SUB AREA

Washington, Oregon and Idaho

Program for runoff and waterflow retardation and soil erosion prevention

May 1954

UNITED STATES DEPARTMENT OF AGRICULTURE

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SURVEY REPORT

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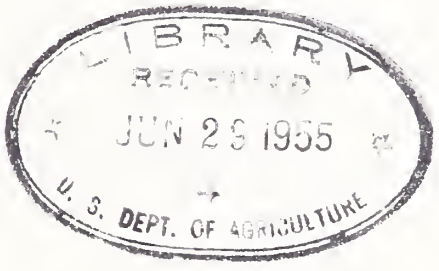
Columbia River Basin Area
Washington, Oregon, and Idaho

Program for Runoff and Waterflow
Retardation and Soil Erosion Prevention



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INTRODUCTION

Authority

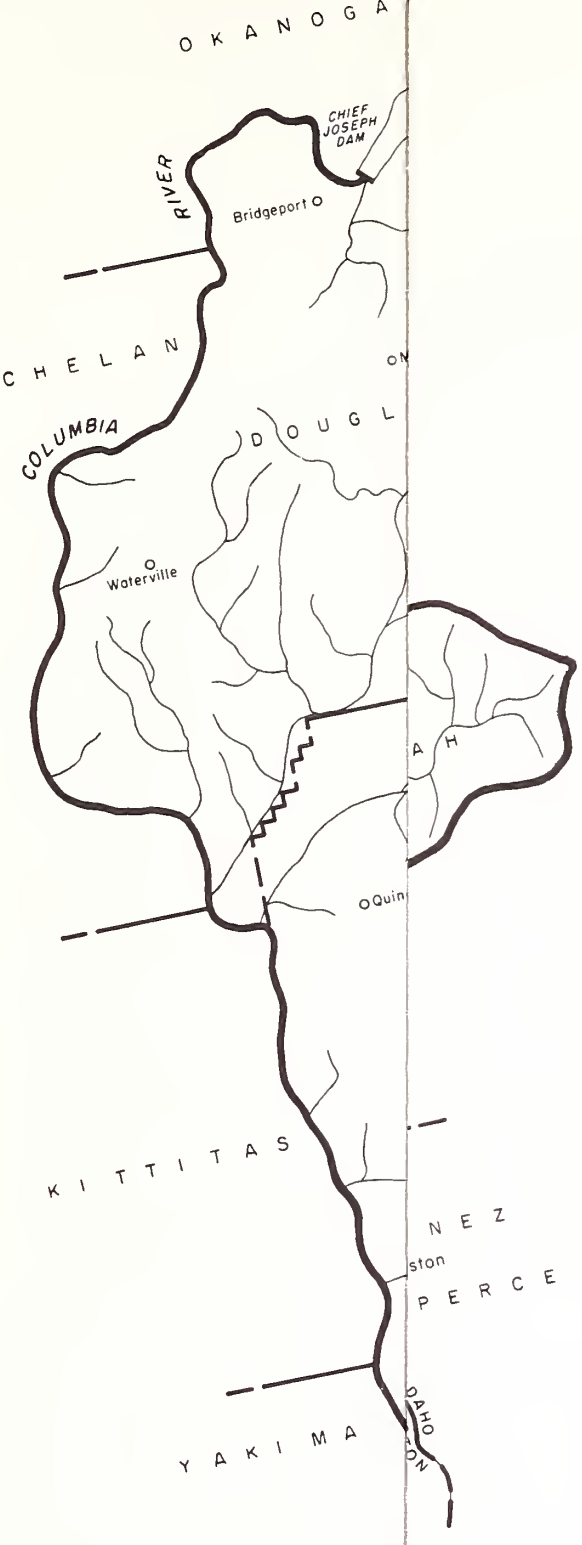
This report is submitted under the provisions of the Flood Control Act approved June 22, 1936 (49 Stat. 1570), as amended and supplemented.

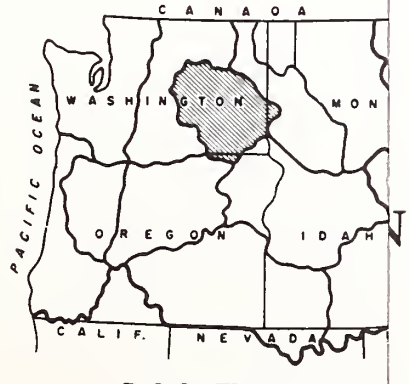
Scope

This report outlines a program of watershed treatment for runoff and waterflow retardation and soil erosion prevention needed in the Big Bend-Palouse-Lower Snake Area. It is mainly in southeastern Washington with small segments in northwestern Idaho and northeastern Oregon (Fig. 1). It includes an area of about 15,780 square miles or 10,100,000 acres.

The watershed program is composed of two groups of measures. One group consists of measures primarily for flood prevention, hereinafter called flood prevention measures (A Measures), which are not normally being installed under existing authorities for current national programs of the Department of Agriculture. The other group consists of measures used for the conservation of watershed lands which contribute directly to flood prevention, hereinafter called land treatment measures (B Measures), and which are being installed under existing authorities for such programs.

This report presents recommendations for the authorization of the flood prevention measures, under the Flood Control Act of June 22, 1936, as amended and supplemented, and for the installation of the land treatment measures under existing authorities concurrently with the flood prevention measures.





LOCATION MAP

Figure 1

ND - PALOUSE - LOWER SNAKE SUB AREA

COLUMBIA RIVER BASIN

1951

10 0 10 20 30

SCALE IN MILES

U.S. DEPARTMENT OF AGRICULTURE

LOCATION MAP

Figure 1

BIG BEND - PALOUSE - LOWER SNAKE SUB AREA

COLUMBIA RIVER BASIN

1951

10 0 10 20 30

SCALE IN MILES

U.S. DEPARTMENT OF AGRICULTURE

Need for the Watershed Program

The program recommended in this report affects the welfare of about 77,000 rural, and 91,000 urban people living within the area. The estimated average annual floodwater and sediment damages for the area total approximately $2,600,000. These damages are caused about equally by floodwater and sedimentation. If other losses such as disease epidemics, dislocations that result from floods, loss of labor, land abandonment, the lack of a stable farm income, and mental anguish caused by floods could be measured in dollars and cents, they would probably exceed the measurable losses.

About half of the damages determined in this area occur to crops as a result of flooding of the bottom lands, sedimentation and overland scour. The other major damage item is the destruction and increased maintenance of public roads and railroads as a result of flooding and sedimentation.

In the wheat producing sections of the area the steepness of the land, the susceptibility of the soil to erosion and the seasonal precipitation has resulted in severe erosion. This, in turn, has caused serious sedimentation problems of increased road maintenance and damage to crops. A continuation of this situation will reduce the effectiveness of the large dams now under construction or proposed for construction on the lower Columbia River. There is urgent need for land use adjustments and conservation measures that will prevent erosion and conserve moisture.

Forage production on the rangelands in the area is now much less than the full potential for these ranges. Present intensity and character of grazing use in many instances will not permit

sustained production, and plant cover on much of the rangeland is not satisfactory from the standpoint of watershed requirements.

RECOMMENDATIONS

It is recommended that:

(a) The Secretary of Agriculture be authorized to install the flood prevention measures on a cost-sharing basis[1/] with local interests during a 20-year period in the Big Bend-Palouse-Lower Snake sub-area of the Columbia River Basin Area under the provisions of the Act of June 22, 1936, as amended and supplemented, except the measures which are proposed for installation under the jurisdiction of a Federal agency other than the Department of Agriculture, and that the head of such other Federal agency be authorized to install the flood prevention measures which are proposed for land under the jurisdiction of such agency. The estimated total Federal cost of all flood prevention measures is $4,850,090.

(b) The land treatment measures, for which no additional authority is requested herein, be applied under existing authorities concurrently with the installation of the flood prevention measures to assure the proper functioning of the program.

(c) As a condition precedent to the installation of the program, cooperating state and local agencies be required to furnish assurances satisfactory to the Secretary of Agriculture with respect to their ability and willingness to operate and maintain the flood prevention measures on non-Federal land.

1/ The share of the cost to be borne by local interests may consist of cash, labor, materials, equipment, land, easements, rights-of-way and other contributions.

(d) The authority of the Secretary of Agriculture, or the head of any other Federal agency concerned, to carry out the flood prevention measures be supplemental to all other authority vested in him, and that nothing in this report shall be construed to limit the exercise of powers heretofore or hereafter conferred on him by law to carry out such measures or other measures that are similar or related thereto.

(e) The Secretary of Agriculture, or the head of any other Federal agency concerned, be authorized to construct such buildings and other improvements as are needed to carry out the flood prevention measures.

DESCRIPTION OF THE WATERSHED

The Big Bend-Palouse-Lower Snake area includes about 15,780 square miles or 10,100,000 acres. It is largely a plateau bounded on the north by Lake Roosevelt (the lake created by Grand Coulee dam), on the west by the Columbia River, and on the south and east by the Blue and Moscow Mountains. It is mainly in southeastern Washington with small segments in northwestern Idaho and northeastern Oregon (Fig. 1).

Elevations above sea level vary from about 380 feet at the mouth of the Walla Walla River in the southwestern part to some 6,500 feet at the Oregon Buttes in the Blue Mountain fringe on the east. The drainage pattern of all the area except the extreme northern edge is toward the southwest into the Snake and Columbia Rivers. In general, this area is a broad basaltic plateau overlaid by loessial type soils and dissected by ancient stream beds

cut by glacial waters to form Moses Coulee, Grand Coulee and the channelled scablands.

Glaciation and deposition occurring since Miocene time accounts for the glacial drift, alluvial, lacustrine and aeolian deposits which cover much of the area. The soils vary in texture, depth and subsoil characteristics depending upon their origin and aeolian cover. The deeper profiles extensively associated with the continental sediments which are largely of loessial origin are found in all parts of the area, but predominantly in the central and eastern sections.

The western part shows a gradual thinning toward the shallow, light to coarse textured soil profiles. The channelled scablands and broad outwash channels are characterized by a very thin mantle of light to coarse textured soils with exposed areas of lava bedrock. Younger alluvial soils of variable depth and texture usually occur as narrow strips along stream channels.

The climate of the area, in general, is temperate and largely semi-arid, although great differences in rainfall occur between the higher and lower elevations. Seasonal distribution of rainfall provides a winter wet season and a summer dry season. The average annual precipitation varies from 6 inches near Pasco, Washington, to over 50 inches on the headwaters of the Walla Walla River in Oregon. Approximately 70% of the annual precipitation occurs during the 6-month period, October through March, much of it as snow.

A semi-continental climate, characterized by wide temperature extremes, is predominant but is tempered somewhat by the mild westerly air currents from the Pacific Ocean. Mean annual recorded temperatures vary from a minimum of 46.3° F. at Potlatch, Idaho, to

53.1° F. at Walla Walla, Washington. Extreme recorded temperatures vary from a high of 118° F. at Wahluke, Washington, to a low of -36° F. at Potlatch.

The relative humidity is low and there is an abundance of clear days.

In 1950 approximately 50 percent of the area was used for cropland and about 2 percent of this land was irrigated. The cultivated lands of the area can be segregated into (1) the irrigated river bottoms and narrow flood plains under 1,000 feet in elevation; (2) the dry farmed wheat land area which extends from 800 feet to 2,000 feet in elevation with precipitation from 8 to 15 inches, and where alternating summer fallow and wheat is the predominant cropping system; and (3) the more humid annual crop area from 1,700 to 3,000 feet in elevation, which receives precipitation of 15 to 30 inches, making it possible to substitute legumes and nitrogen fertilizer for summer fallow in crop rotations and produce some of the highest field yields of wheat in the nation.

Rangelands account for about 42 percent of the area and are used for grazing sheep and cattle. The rangelands are located mainly on the fringe areas, scablands and "breaks" along water courses and coulees.

Forests account for only about 6 percent of the area and are only slightly less extensive than when settlement of the area first occurred. The remaining 2 percent of the land is occupied by roads, railroads, cities and towns or waste land.

In 1950 about 9,000 farms were reported in the area. The number of farms has decreased almost steadily since 1910 and decreased by 16 percent during the period 1940-50.

There are approximately 8.3 million acres of land in farms and about 60 percent of it is classified as cropland. The cropland is used predominantly for the production of wheat and other small grains. In addition to the farms producing grain as a cash crop, there are 700 livestock, 400 fruit, 300 dairy, 300 general, 160 poultry and 130 vegetable farms.

At the present time irrigation is of relatively minor importance in the area with irrigation reported on only 1,676 farms in 1950. However, the area is undergoing significant changes. Irrigation water is now being made available on parts of the Columbia Basin Project of the Bureau of Reclamation and it is estimated that about a million acres of land will be irrigated under this project in the Big Bend area. This will mean the creation of many new farm units and a change in land use from dry farming and range to intensive irrigation use.

The population of the area was 168,000 in 1950, an increase of 85 percent since 1900. About 91,000 persons were classified as urban and 77,000 as rural. The largest city in the area is Walla Walla, Washington, with a population of 24,102 reported in 1950. Pasco, Washington and Moscow, Idaho reported slightly more than 10,000 population each and Pullman, Washington 12,000. These four cities account for about 62 percent of the urban population of the area.

FLOODWATER AND SEDIMENT PROBLEMS

Floodwater and sediment problems in the Big Bend-Palouse-Lower Snake area are due to three general types of flood occurrences. There are periodic main stream floods, local annual floods on the tributary streams in agricultural areas, and summer "cloudburst" type floods. The source of runoff for the annual floods is almost entirely cultivated land. The first two types of flood are associated with rain storms of low intensity and long duration with warm "chinook" winds which cause rapid melting of snow.

Minor floods occur at 2 to 5 year intervals, and major floods about once in 25 years. Major floods seldom occur over the entire area in one year. There were disastrous floods in the Walla Walla watershed in 1882, 1906, and 1931, of a frequency of about once in 25 years. On the Palouse River, major floods were recorded in 1910, 1933, and 1948, with three floods of major proportions over a two-month period in the latter year.

Damages by sedimentation are as large as the damages by floodwater in this area. Erosion is particularly severe in the wheat producing area extending from the southern boundary near Walla Walla north to Spokane. During the four years 1948-1952 an average of 3,000,000 acres in the watershed lost more than 12 tons of soil per acre per year. Sediment carried off the fields by melting snow and rain is deposited on growing crops, roads, railroads, and in road, irrigation and drainage ditches. Sediment also clogs streams, and deposits on flood plains and in ponds. Sediment reaching the

major streams is largely carried into the Columbia River and deposited behind dams, in the lower reach of the river, or is carried out to sea.

Damage Areas

Floodwater and sediment damage is more frequent and severe in the zone where the annual precipitation exceeds 16 inches. In this zone during the late winter and early spring partly frozen saturated soil produces a high rate of runoff and heavy deposition of sediment on crops, roads, ditches and other installations. Urban centers throughout the annual cropping zone are also subject to considerable flood water and sediment damage during periods of major peak flows.

The zone with rainfall of 10 to 16 inches annually produces, as a rule, only moderate runoff because of deep soils with sufficient capacity to retain normal precipitation and because of comparatively gentle slopes. Floods that do occur are the result of heavy spring or fall rains with intensities that exceed the infiltration rates of the soil. Floodwater and sediment damages chiefly affect crop areas at the base of the hills, county roads and the areas subject to inundation along major drainageways.

The low-lying plateau area of the southwest portion of the area experiences only infrequent floodwater and sediment damage. The annual rainfall in this area is from 6 to 10 inches.

Floodwater and Sediment Damages

The estimated average annual floodwater and sediment damages for the Big Bend-Palouse-Lower Snake area total approximately $2,600,000 (Table 1). These damages have been converted to long-

Table 1 - Estimated average annual damage
Big Bend-Palouse-Lower Snake Area
(long-term projected prices)

Type of damage		Average annual damages
Floodwater damage		
Crops		$ 244,881
Property		75,377
Land loss		99,188
Farm roads and bridges		14,645
Farm irrigation and drainage		1,573
Other agricultural		12,198
Group irrigation and drainage		4,317
Public roads and railroads		522,895
Other major stream damages 1/		132,228
	Subtotal	$ 1,107,302
Sediment damage		
Crops and improvements		$ 426,886
Land		58,155
Farm irrigation and drainage systems		1,923
Farm roads and bridges		27,197
Other agricultural		9,022
Stock ponds and reservoirs		5,065
Group irrigation and drainage		4,677
Public roads and railroads		593,650
Other major stream damages 1/		33,057
	Subtotal	$ 1,159,632
Indirect damages		332,763
	Total average annual damages	$2,599,697

1/ Damages reported by Corps of Engineers, which will remain after installation of authorized projects.

term projected prices by multiplying the damages collected based on 1949 prices by a conversion factor.

Agricultural damages were determined on a sample stream basis and expanded to all streams in the area according to similarity of characteristics. As the Corps of Engineers had completed damage surveys along major streams and some of the minor tributaries in this area, this investigation was limited to the minor tributaries not surveyed and the watershed lands.

The streams or portions of streams in the area were classified into groups with similar damage characteristics. The classification was made by a reconnaissance survey of each stream, taking into consideration the following factors: (1) topography and watershed cover; (2) flood plain cover and types of agricultural crops subject to damage; (3) the extent of possible damage due to cultural development of the flood plain; (4) size of the floodplain; (5) type of soil; (6) the extent to which irrigation facilities had been developed, and (7) the general hydrologic characteristics of the area.

The sample streams were selected as representative of groups of streams having similar characteristics indicating a similarity in damage experience.

ACTIVITIES RELATED TO FLOOD CONTROL

The Congress of the United States has authorized the Department of the Army, Corps of Engineers, to construct flood control projects on segments of Walla Walla and Touchet Rivers and Mill Creek in the Walla Wall River watershed as described in House Document 578, 75th Congress, 3rd Session. The flood control works authorized consist

of an off-stream reservoir, diversion and channel improvements on Mill Creek to protect the city of Walla Walla; and channel enlargement, improvement and stabilization through Milton and Freewater on the Walla Walla River, and Dayton and Waitsburg on the Touchet River. Most of this work has been completed except for the major work proposed on the Touchet River.

The proposals of the Corps of Engineers for control of flood in the watershed as described in House Document 308, 69th Congress, 1st Session and House Document 578, 75th Congress, 3rd Session, were reviewed in a survey as reported in Review Report, Columbia River and Tributaries, 1949. Further control works in selected main stream reaches were authorized by Congress in Public Law 516, 81st Congress, 2nd Session, substantially in accordance with recommendations contained in the Review Report.

The four dams authorized for installation on the Lower Snake River; Ice Harbor; Lower Monumental; Little Goose; and Lower Granite; would not be significantly effective in reducing flood damages in the area as there is only a very small amount of flood plain along this section of the river and no storage capacity will be provided in these structures for flood control.

The Grand Coulee dam and the Chief Joseph dam, which is nearing completion, on the Columbia River will reduce floods on the Columbia River but the agricultural damages affected by this control are not of major significance in the area. The irrigation of about one million acres of land under the Columbia Basin Project of the Bureau of Reclamation with water provided from Lake Roosevelt may

introduce new flood problems in the area as a result of the changed soil-moisture relations that will exist.

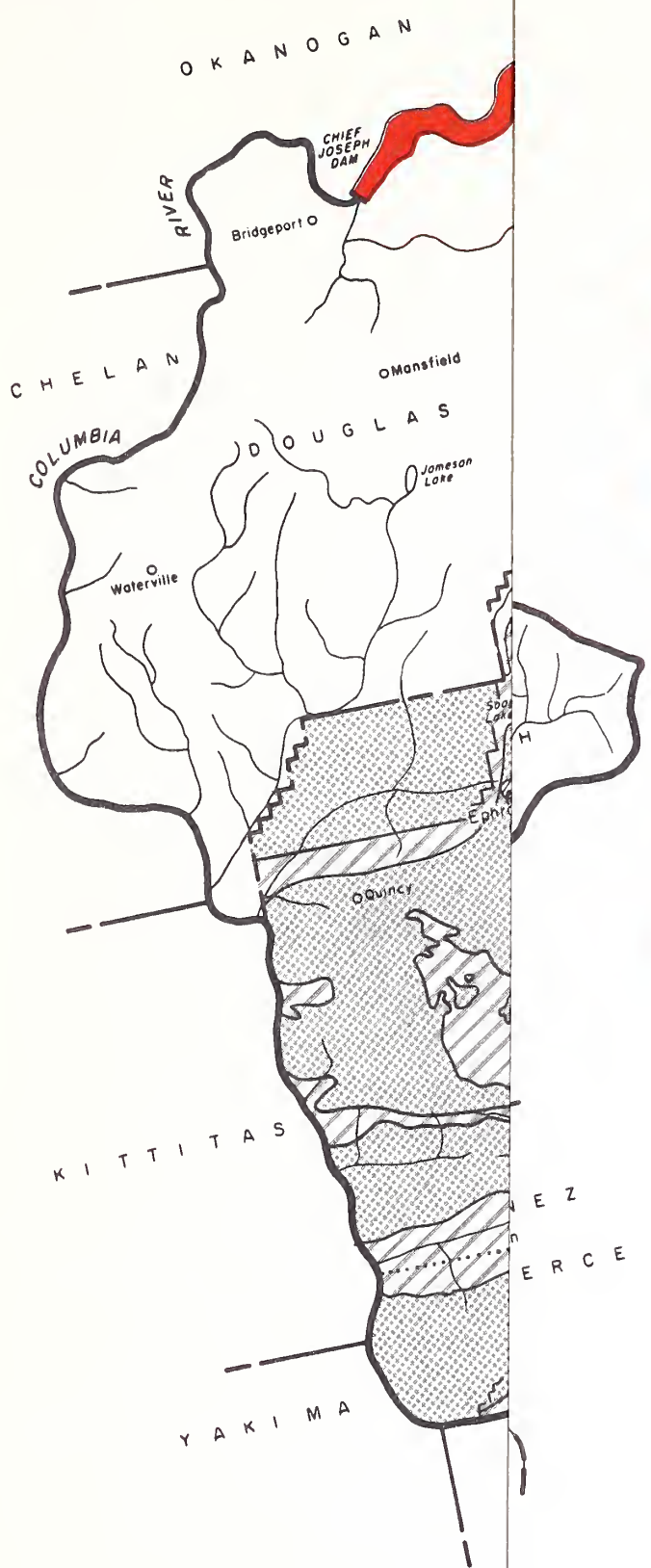
The works of other agencies affecting flood and water problems is shown on Figure 2.

There are 30 soil conservation districts which cover approximately 75 percent of the area. They receive Federal assistance (principally technical services) from the Soil Conservation Service in farm planning and application of soil and water conservation practices and measures, many of which have value in retarding runoff and preventing erosion.

The Umatilla and St. Joe National Forests are partially in the area. Forest Service management of these areas has caused improved cover and soil conditions by improved logging methods and reductions in overgrazing on national forest lands, and by fire control on both national forest and adjacent privately owned land.

The Agricultural Stabilization and Conservation Program is making payments to land owners and operators to help defray costs of conservation measures. This is aiding in the establishment of waterflow retardation and erosion prevention measures such as improved rotations; use of green manure and cover crops; construction of terraces; waterways, and erosion control dams; and the establishment or adoption of strip cropping and contour tillage.

The Extension Service, in cooperation with the counties and states, is actively engaged in conducting educational activities to aid in the adoption and use of soil and water conserving methods of farming which will retard waterflow and prevent erosion.



LEGEND

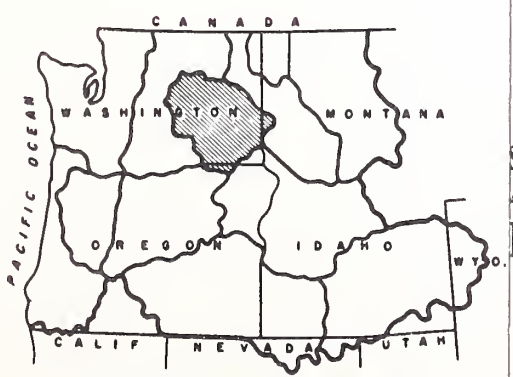
FLOOD CONTROL WORK BY CORP OF ENGINEERS

- Flood control structures completed or under construction.
- Authorized channel alignment and stabilization or reservoirs.
- Proposed chonnel alignment and stabilization.

IRRIGATION DEVELOPMENT BY BUREAU OF RECLAMATION

Columbia River Basin Project Authorized And Under Construction

- Areas proposed for irrigation.
- Areas not suitable for irrigation.
- Storage works completed.



LOCATION MAP

FIGURE 2

S BY OTHER AGENCIES AFFECTING OOD AND WATER PROBLEMS

D - PALOUSE - LOWER SNAKE SUB AREA

COLUMBIA RIVER BASIN

1953

10 0 10 20 30

SCALE IN MILES

LOCATION MAP

LEGEND

FLOOD CONTROL WORK BY CORP OF ENGINEERS

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SCALE IN MILES

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WORKS BY OTHER AGENCIES AFFECTING FLOOD AND WATER PROBLEMS

BIG BEND - PALOUSE - LOWER SNAKE SUB AREA

COLUMBIA RIVER BASIN

1953

RECOMMENDED PROGRAM

The program recommended is designed to meet the needs of the Big Bend-Palouse-Lower Snake area for runoff and water flow retardation and soil erosion prevention. It consists of two groups of measures, which are designed as flood prevention measures (A measures), and land treatment measures (B measures).

The flood prevention measures were developed by studying representative sample areas to determine the types and quantities of measures needed and their economic feasibility. These studies assumed that the land treatment measures would be installed at a comparable rate with the installation of the flood prevention measures in order to complete the watershed program within a period of 20 years and achieve the benefits estimated in this report.

As explained in the section "Floodwater and Sediment Problems" the watersheds, or portions of watersheds, in the area were classified into groups with similar damage characteristics. This classification assisted in the selection of sample watersheds for program development which would be representative of each group of watersheds having similar characteristics. Detailed studies were made of present conditions in these sample watersheds to develop the most effective means for reducing floodwater and sediment damages. Various combinations of measures were considered in determining the most effective and economical program for alleviating the flood damages in these watersheds. The total program for the area was largely determined by expanding the programs developed for the sample watersheds to the entire area.

The recommended flood prevention and land treatment measures are described in the following sections of this report.

FLOOD PREVENTION MEASURES

(A Measures)

Floodwater Retarding Structures. The construction of 22 floodwater retarding structures is proposed for the Walla Walla watershed.

Stabilization and Sediment Control Structures. Thirty-four stabilization and sediment control structures are proposed near the mouths of tributaries entering the Columbia River. Most of these structures will serve as debris collectors to prevent damage to orchard lands on and near the fans built up at the canyon openings. Either a state or county highway crosses most of the fan areas included in the program.

Stabilization of Critical Runoff and Sediment Producing Areas.

Practices for erosion control on critical areas include measures needed for erosion and drainage control on roads and trails, stabilization of slips and slides and severe sheet erosion control. Roadside and trail erosion control is needed along 538 miles of rights-of-way throughout the watershed. Because the topography is rolling, road construction has necessitated making cuts with rather steep banks that are left bare and unprotected. The borrow pits, in many cases, are on grades that erode badly.

The practices to stabilize slips, slides and gullies are needed on about 85 acres in the steeper areas in the eastern part of the watershed in Whitman, Garfield and Columbia Counties. Sheet erosion control practices are needed on public lands that are denuded of

vegetation and are sources of accelerated runoff and sediment. The total area to be treated is 5,120 acres.

Stream Channel Improvement. Tributary channel improvements include clearing, enlarging, realigning, riprapping, vegetating, revetment and cleaning of debris. All are included as needed in the 505 miles of channel improvement proposed.

Included in the channel improvement, are the 395 waterway stabilization structures proposed. They are required to prevent deepening of watercourses into unmanageable gullies. They will also reclaim, by sediment deposition, some of the gullies now formed.

Subwatershed Waterway Improvement. About 12 miles of subwatershed waterway improvement is required.

LAND TREATMENT MEASURES

(B Measures)

Contour Farming is needed on approximately 1,688,900 acres and contour strips on 1,122,500 acres in this area. This is farming slopes whereby plowing, planting, cultivating, and harvest operations in the production of field crops, and in orchards and vineyards, follow lines that are level or conform to accepted standards for grade. These practices will aid materially in reducing runoff and stabilizing the topsoil.

Terraces. Approximately 450 miles of terraces are recommended for construction on sloping and undulating cropland. Terraces are graded channels across the slope to intercept and control runoff and minimize erosion. The channels are constructed with supporting ridges on the lower sides and are laid out in a manner to permit

them to be cultivated with the field. Terraces of proper design divide long slopes and intercept the runoff water before it accumulates into damaging amounts.

Field Diversions. Approximately 1,200 miles of field diversions are needed on the cropland in the area. They are graded channels across the slope, to intercept runoff water from upper areas or at regular intervals across cultivated areas. These channels are constructed with supporting ridges on the lower side and are not cultivated with the field. They are usually protected by vegetation. Field diversions are often used to divert the runoff water from relatively steep upper rangeland from crossing lower-lying cropland. They are also used on slopes that are too steep for terraces and as temporary protection for drainage areas while sodded waterways are being established.

Vegetated Waterways. There are approximately 18,000 miles of vegetated channels needed. This measure includes shaping the channels and planting them to permanent vegetative cover. They are required largely on grain lands.

Crop Residue Utilization is needed on approximately 2,940,000 acres. This is utilizing vegetative materials on orchards, vineyards and croplands, such as straw, stubble, prunings, and other crop residues, in such a manner as to reduce wind and water erosion, conserve moisture and improve the soil. It includes mixing the materials into the soil or leaving them wholly or partially on the surface.

Subsoiling is needed on approximately 407,400 acres of the cropland. This practice is tilling the soil at least 18 inches

deep to break up the plow sole, heavy clay subsoil, or a calcareous layer which often forms in the subsoils of arid regions. This practice can be used to good advantage periodically on those soils that have a tight layer, not more than three feet below the ground surface, which restricts the passage of water and roots into the subsoil.

Cover Cropping. Cover crops are needed for the protection of approximately 844,200 acres of the cropland. This practice is planting annuals and biennials primarily to provide cover for erosion prevention on sloping land.

Rotation Seeding. The seeding of perennial grasses and legumes in a desirable crop rotation system is needed on approximately 1,060,500 acres of cropland. This does not include the annual and biennial grasses and legumes used for green manure and cover crops. Rotation seedings are effective in building up soil fertility and soil structure and counteracting the losses from soil-depleting crops.

Pasture Seedings are recommended for approximately 240,000 acres. This practice is the establishment of forage plants for pasture, by seeding, sprigging or other methods.

Pasture Management is needed on approximately 466,000 acres. This is maintaining a protective cover of vegetation in a manner which will increase forage, check erosion, restore or increase soil fertility and improve soil moisture conditions.

Fertilizing. Fertilizing to establish soil conserving crops is needed on about 40,400 acres. The major fertilizer elements needed for that purpose are nitrogen and phosphorus.

Seeding and Planting. It is recommended that about 510,500 acres of privately-owned and 9,500 acres of Federal land be seeded or planted to grasses, herbaceous plants or shrubs. This practice includes the establishment of protective cover where natural revegetation will not restore cover within a reasonable period of time, where unpalatable weeds and shrubs predominate, and on lands to be converted from cropland to rangeland. It does not include the seeding and planting of gullies and critical erosion sites.

Fertilizing. It is recommended that 339,800 of the privately-owned and 375 of the Federal acres recommended for seeing and planting be fertilized (about 20 pounds of nitrogen per acre) to assist in the establishment of a vigorous and productive stand.

Fences. It is recommended that about 1,400 miles on privately-owned land and 120 miles on Federal land of cross and drift and protective fencing be constructed for the proper control and distribution of livestock and to protect new seedings on range lands until the plants become established.

Driveways and Driftways. It is recommended that about 100 miles on privately-owned land and 10 miles on Federal land of driveways and driftways be provided.

The construction of driveways are sometimes necessary to eliminate livestock travel from roads or to provide definite routes for livestock travel between roads and distant range allotments or areas.

Water Developments. Additional water developments such as spring developments, wells, or ponds are needed to provide livestock

water; 2,636 are required on privately-owned lands and 19 on Federal land. These developments would permit better distribution of livestock on the ranges.

Water Spreading and Irrigation. Water spreading and irrigation is recommended for about 4,000 acres of privately-owned land and 3,300 acres of Federal land. Under this practice are included the construction of facilities to divert runoff water from watercourses or gullies onto adjacent grazing lands.

Rodent Control is needed to reduce populations of jackrabbits, porcupines, ground squirrels, gophers and mice. These animals in many instances are causing considerable damage to range and timber, and preventing the establishment of new stands. This practice is needed on about 50,200 acres of privately-owned and 31,800 acres of Federal range and forest land.

Proper Stocking. This practice is recommended for about 1,562,400 acres. This management practice is the grazing of land at such intensity as will make proper use of available forage. Proper use rates will leave sufficient vegetation to control erosion.

Deferred Grazing is recommended on about 670,640 acres. Deferred grazing is the postponement of grazing through the growing and seed development period of the more important plants to permit seed production, seedling establishment, and the recovery of the forage plants.

Fire Control Improvements. This practice includes the construction of lookout towers, clearing of firebreaks, snag felling, disposal of slash and debris, and other work needed to reduce fire

hazards and increase the efficiency of the fire protection organization. It is required to protect about 2,300,000 acres of rangeland.

Planting Forest Trees. This includes the establishment or reestablishment of a forest cover for timber production and watershed protection purposes, either by direct seeding or by planting nursery stock, and applies both to reforestation of non-stocked areas and to interplanting thin stands to attain full protective use and productive capacity of the site. Needs are for 3,660 acres on Federal lands and 23,800 acres on private lands. The cost of this tree planting will be in addition to regular agency activities.

Revegetation of Woody Shrubs. This measure is required on about 10,400 acres. It is primarily to provide food and cover for wildlife but has a secondary flood prevention benefit as a result of stabilizing the types of lands for which it is recommended. The cost of installing and maintaining this measure will be in addition to regular agency activities.

Cooperative Fire Control. This includes fire control on non-Federal lands by Federal cooperation with states.

Fire Control - Federal Lands. This item includes equipment, construction of towers, buildings and other facilities for effecting a fire control program on Federal lands. It also includes clearing of fire breaks, snag felling, disposal of slash and debris, and other work needed to reduce fire hazards and increase the efficiency of the fire protection organization. The cost of installing and maintaining this measure will be in addition to regular agency activities.

Technical Services - Openland. Technical services will be made available for planning and applying the necessary land use adjustments, for planning and applying conservation measures on cropland and rangeland, and for integrating these measures with other measures in the recommended program.

Plan Preparation is required for coordinating the use of Federal lands with private lands for grazing purposes.

Educational Assistance will be provided in accordance with the need, purposes and objectives of the program. Intensified educational efforts will be directed toward familiarizing farmers and ranchers with the specific practices essential to waterflow retardation and prevention of soil erosion.

COST OF RECOMMENDED PROGRAM

The estimated cost of installing both the flood prevention ("A") measures and the land treatment ("B") measures is $56,361,239 based on projected long-term prices (see Tables 2 and 3). It is estimated that local interests will provide about 82 percent of the cost of installing these measures; however, the allocation of Federal and non-Federal costs will vary by types of measures. The cost of land treatment measures on privately-owned land will generally be borne entirely by individual landowners and operators except for technical assistance since most of the benefit will accrue directly to the land on which the measures are applied. Flood prevention measures, on the other hand, produce public benefits often of a dispersed nature, and extending far downstream. The Federal government will install these measures on a cost-sharing

Table 2.-- Estimated cost of installing flood prevention measures
(A Measures)
Big Bend-Palouse-Lower Snake
(long-term projected prices)

Measures	Unit	Quantity	Costs		
			Federal	Non-Federal	Total
			dollars	dollars	dollars
Floodwater retarding structures					
Non-Federal land	Each	22	1,602,668	534,222	2,136,890
Stabilization and sediment control structures					
Federal land	Each	21	74,760		74,760
Non-Federal land	Each	13	204,255	68,085	272,340
Stream channel improvement					
Tributary channels					
Federal land	Miles	15	26,700		26,700
Non-Federal land	Miles	490	1,471,170	490,390	1,961,560
Stabilization structures					
Non-Federal land	Each	395	1,044,638	348,212	1,392,850
Stabilization critical runoff and sediment producing areas					
Sheet erosion control					
Federal land	Acres	2,900	129,940		129,940
Non-Federal land	Acres	2,220	72,691	24,230	96,921
Slide stabilization					
Federal land	Acres	11	45,746		45,746
Non-Federal land	Acres	74	31,840	10,613	42,453
Road erosion control					
Federal land	Miles	240	80,634		80,634
Non-Federal land	Miles	298	49,440	49,439	98,879
Subwatershed waterway improvement					
Federal land	Miles	2	3,827		3,827
Non-Federal land	Miles	10.3	11,781	3,927	15,708
Subtotal Federal land			361,607		361,607
Subtotal Non-Federal land			4,488,483	1,529,118	6,017,601
Total			4,850,090	1,529,118	6,379,208

Table 3.--Estimated cost of installing land treatment measures
Big Bend-Palouse-Lower Snake Area
(long-term projected prices)

Measures	Unit	Quantity	Costs		
			Federal	Non-Federal	Total
			dollars	dollars	dollars
Contour stripping and planting	Acres	1,122,500		1,013,596	1,013,596
Terracing	Miles	450		39,044	39,044
Field diversions	"	1,200		204,164	204,164
Vegetated waterways	"	18,000		1,990,470	1,990,470
Contour farming	Acres	1,688,900		358,792	358,792
Crop residue utilization	"	2,939,250		7,583,650	7,583,650
Subsoiling	"	407,355		2,905,940	2,905,940
Cover cropping	"	844,200		7,260,120	7,260,120
Rotation hay & pasture seeding	"	1,060,490		10,944,360	10,944,360
Pasture seeding	"	240,000		3,096,516	3,096,516
Pasture management	"	465,900		1,202,151	1,202,151
Fertilizing-Est. cons. crops	"	40,410		417,134	417,134
Range improvement					
Seeding grasses and herbs					
Federal land	Acres	9,500	72,283		72,283
Non-Federal land	"	510,500		3,472,473	3,472,473
Fertilizing					
Federal land	Acres	375	6,450		6,450
Non-Federal land	"	339,800		1,463,720	1,463,720
Water spreading and irrigation					
Federal land	Acres	3,300	70,950		70,950
Non-Federal land	"	4,000		27,520	27,520
Stockwater facilities					
Federal land	Each	19	7,504		7,504
Non-Federal land	"	2,636		778,472	778,472
Fencing					
Federal land	Miles	121.5	93,422		93,422
Non-Federal land	"	1,400.5		757,308	757,308
Driveways and driftways					
Federal land	Miles	9.5	2,425		2,425
Non-Federal land	"	101		33,626	33,626
Misc. stock handling facilities					
Federal land	Each	26	16,942		16,942
Non-Federal land	"	27		17,415	17,415
Rodent control					
Federal land	Acres	31,770	24,175		24,175
Non-Federal land	"	50,190		21,581	21,581
Stream improvement					
Federal land	Miles	2.7	1,389		1,389
Non-Federal land	"	4.7		2,399	2,399

(continued)

Table 3.--Estimated cost of installing land treatment measures
Big Bend-Palouse-Lower Snake Area
(long-term projected prices)

Measures	Unit	Quantity	Costs		
			Federal	Non-Federal	Total
			dollars	dollars	dollars
Range management					
Proper stocking	Acres	1,562,400		67,183	67,183
Deferred grazing	"	670,640		57,654	57,654
Fire protection	"	2,289,600		59,072	59,072
Tree planting					
Federal land	Acres	3,660	109,908		109,908
Non-Federal land	"	23,800	35,943	682,907	718,850
Revegetation of woody shrubs					
Federal land	Acres	10,030	125,904		125,904
Non-Federal land	"	400		1,737	1,737
Cooperative fire control			38,978	38,977	77,955
Fire control - Federal land			613,670		613,670
Technical Services (openland)			4,248,300		4,248,300
Plan preparation					
Federal land			12,840		12,840
Non-Federal land				2,967	2,967
Subtotal Federal land			1,157,862		1,157,862
Subtotal Non-Federal land			4,323,221	44,500,948	48,824,169
Total			5,481,083	44,500,948	49,982,031

basis. The cost of installing, operating and maintaining the measures on Federal land will be borne by the agencies responsible for the administration of such land.

Total average annual costs of the program are estimated at $13,646,242. This was arrived at by amortizing public installation costs at 2 1/2 percent interest and private costs at 4 percent over a 50-year period, plus estimated annual operation and maintenance costs. In the case of recurring measures, the initial once over costs were amortized as an installation cost and the recurring costs were treated as average annual operation and maintenance.

Approximately $12,926,579, or over 95 percent of the total average annual costs are expected to be borne by local interests.1/ The annual cost to the Federal government will be about $719,663, of which $95,400 will be on Federal lands.

FLOOD PREVENTION MEASURES

(A Measures)

The estimated cost of installing the flood prevention measures is $6,379,208 (Table 2). Of this cost, it is estimated that the Federal government will expend $361,607 on Federal land and $4,488,483 on non-Federal land. Local interests will expend about $1,529,118 on non-Federal land.

Local interests will be required to furnish without cost to the Federal government all land, easements, and rights-of-way needed in connection with the installation of the flood prevention measures; and will be expected to make any additional contributions that may be necessary to meet their proportionate share of the cost of installing these measures as determined by the Secretary of Agriculture

1/ Does not take into accounty any ASC payments.

to be equitable in consideration of the anticipated benefits from such measures.

The total estimated average annual cost of the "A" measure program is $337,045. Based on the anticipated source of funds for installation and operation and maintenance costs in accordance with the nature of the measure and the ownership of land on which installed, about 53 percent, or $178,863 will be expended by the Federal government. Of this latter amount $20,600 is on Federal land.

LAND TREATMENT MEASURES

(B Measures)

The estimated cost of installing the land treatment measures is $49,982,031. Of this cost, it is estimated that the Federal government will expend $1,157,862 on Federal land and $4,323,221 on non-Federal land, and that local interests will expend $44,500,948 on non-Federal land. The estimated Federal cost of these measures on non-Federal land does not include financial assistance by the Federal government such as Agricultural Stabilization and Conservation Program payments to landowners and operators. Any assistance of this kind that may be provided at the time of program installation will help landowners and operators in installing the program.

The estimated total annual cost of these land treatment measures is $13,078,987. Of this amount the Federal government will expend $74,800 on Federal land and $275,386 on non-Federal land, including $110,000 for annual cost of accelerated educational assistance, and local interests will expend $12,728,801 on non-Federal land.

BENEFITS FROM THE RECOMMENDED PROGRAM

The recommended program will reduce floodwater and sediment damages and increase production. It is estimated that the program will reduce floodwater and sediment damage in the area by approximately 60 percent.

It is estimated that the sediment damage will be reduced by 71 percent and the floodwater damage by 46 percent; that agricultural damages will be reduced by 61 percent; and that damage to public roads and railroads will be reduced by 57 percent. Other benefits will accrue from better use of cultivated land, more usable forage production and reduced losses by fire, as a result of the land treatment measures.

The full attainment of the benefits evaluated in this report is dependent upon the cooperation and support of land owners and operators and local agencies in installing and maintaining the recommended measures.

The estimated average annual benefit that will be obtained by the recommended program for the Big Bend-Palouse-Lower Snake Area is summarized in Table 4.

In addition to the monetary benefit, there will be unevaluated benefits such as reduction of hazards to life and health; reduced anguish caused by floods; increased recreational opportunities, and better habitats for wildlife.

COMPARISON OF BENEFIT AND COST

The ratio of the estimated average annual monetary benefit of $715,855 to the estimated average annual value of the total cost

Table 4.--Estimated average annual benefits from the recommended program Big Bend-Palouse-Lower Snake Area (long-term projected prices)

Source	Average Annual Benefits dollars
Reduction of floodwater damages	513,726
Reduction of sediment damages	828,385
Reduction of indirect damages	230,538
More intensive land use	117,418
Conservation benefits	
Cropland	18,097,240
Range land	1,848,204
Forest land	459,264
Total program benefits	22,094,775

of $337,045 of the Flood Prevention measures (A Measures) is 2.12 to 1.

The ratio of the estimated average annual monetary benefit of $21,378,920 to the estimated average annual value of the total cost of $13,078,987 of the Land Treatment measures (B Measures) is 1.63 to 1.

The ratio of the estimated average annual monetary benefit of $22,094,775 to the estimated average annual value of the total cost of $13,416,032 of the total program (A and B Measures) is 1.65 to 1.

These ratios have been computed on the basis of long-term projected prices.